Evaluating a Comprehensive Outpatient Clinical Information System: A Case Study and Model for System Evaluation

Homer L. Chin, M.D.
Assistant Regional Medical Director

Peggy McClure, MBA
Manager, Clinical Systems

Kaiser Permanente, Northwest Region
Portland, Oregon

ABSTRACT

Decisions about information system implementation are often justified through a cost-benefit analysis. The ability to improve efficiency and outcomes while decreasing costs through information systems -- by allowing for multiple and instant simultaneous access to information, through data monitoring and alerting, through automation of protocols, and by collecting information for population-based health care as opposed to individual illness-care -- are all potential benefits of a comprehensive clinical information system. Measuring the quantitative impact of these system improvements, however, is difficult. Doing a complete cost-benefit analysis of a comprehensive clinical information system is unrealistic due to the many assumptions necessary and the multiple confounding factors that are involved. In our Clinical Information Systems deployment in Kaiser Permanente, Northwest Region, we have elected not to do a detailed cost-benefit analysis. Instead, we have done an evaluation , based on success criteria, of a pilot implementation of a vendor-supplied system. This evaluation is based on clinician acceptance, system usage, technical factors, and quantitative effects on physician productivity. We also considered qualitative factors such as relationship with and responsiveness of the system vendor. We are moving ahead to regionalize this clinical information system based on such an evaluation of our pilot project. This paper outlines the approach that we have taken in evaluating our implementation of this system. It may provide some guidance for organizations on how to make a decision about whether or not to regionalize a clinical information system based on the evaluation of a pilot-site implementation.

BACKGROUND

The Northwest Region of Kaiser Permanente, based in Portland, Oregon, is taking a phased approach to the implementation of Clinical Information Systems (CIS).

The first phase of our CIS development is essentially complete. This phase has fully leveraged the information already existing in our data systems. We have developed a centralized clinical data repository that receives and stores all pharmacy, laboratory, appointment, demographic, radiology, pathology, and all dictated reports (including consultations, admission histories and physicals, and discharge summaries) generated within our health-care system. This patient-centered database and reporting system allows a clinician to view all clinically relevant information about a patient quickly and easily.

In the second phase of our CIS development, we are implementing a vendor-supplied comprehensive outpatient clinical information system (EpicCare). This client/server based system allows physicians to document encounters, code diagnoses and procedures, maintain problem lists, transmit laboratory and radiology orders, and send prescriptions electronically. In addition, it is capable of sending patient-specific messages and referrals between medical providers. Starting in July 1994, we implemented a pilot system in two medical offices. Forty-six primary care clinicians are now using this system day-in and day-out in the delivery of health care. In November 1994, we undertook an evaluation of this system. This paper discusses the approach that we took in our evaluation. and the results of that evaluation.

METHODS

High Level Goals:

Benefits from implementation of a Clinical information systems may accrue from: Improving health outcomes, lowering operating costs through improvement in efficiency, improving revenue capture, improving member satisfaction, and by capturing data to support management and analytical systems. In the first step of our analysis, we identified these benefits as desired high level end-goals for our CIS implementation.

A quantitative measurement of the extent of achievement of many of these high level goals from a pilot-site implementation is impractical. The ability to quantitate the benefit, and to ascribe any improvement in the degree of achievement of these high level goals to the implementation of a specific information system is not feasible. Table 1 shows

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each of these high level goals, and comments about each. Of the five high level goals, significant difficulty would have been encountered in attempting to quantitate the benefit in four of them.

* GOAL I: IMPROVE HEALTH OUTCOMES:
  - Difficult to measure
  - Confounding variables
  - Dependent on complete implementation of CIS
  - Effect not measurable in time-frame of pilot
* GOAL II: LOWER OPERATING COSTS:
  - Total effect difficult to measure
  - Components, such as "charts pulled per day" can be measured

GOAL III: IMPROVE REVENUE CAPTURE:
  - Documentation for billing

* GOAL IV: IMPROVE MEMBER/GROUP SATISFACTION:
  - Benefit from system difficult to separate from other service improvement initiatives
  - Components, such as reduced wait at pharmacy, can be measured
* GOAL V: SUPPORT MANAGEMENT AND ANALYTICAL SYSTEMS:
  - Diagnosis and Cost Data
  - Referral Data
  - Completeness and accuracy of coding
  - Overall effect difficult to measure

* = Difficult to quantitate benefit from system implementation

Table 1: Comments on Each High Level Goal

What Does Success Look Like?

Using a second approach, we tried to answer the question: What does success look like? Table 2 shows a list of "minimum criteria" that were felt to be necessary in a successful CIS.

- √ High user acceptance
- √ Clinicians are as "productive" as they were before
- √ High patient acceptance
- √ High usage for:
  - √ Entry of visit diagnosis and code
  - √ Problem list maintenance
  - √ Procedure and E/M coding
  - √ Prescribing
  - √ Ordering labs and radiology studies
  - √ Sending referrals
- √ Technically adequate (good performance, stability of product, no loss of data, etc.)
- √ Flexible and modifiable system
- √ Good relationship with and responsive vendor
- √ Good organizational ability to regionalize system

Table 2: Criteria for a Successful System

Because of the difficulty in measuring the effect of the system on the High Level Goals (Table 1), we based our evaluation on the measures in Table 2.

Evaluation Process:

We surveyed the users of the system two and four months after initial implementation of the system. We measured the time spent of various tasks performed during a clinical encounter. Data on the number of patients seen by providers was also obtained and analyzed. Patient acceptance was measured indirectly through clinician surveys. Data collected by the system was analyzed to measure usage of the system. Technical issues, flexibility, modifiability, and vendor issues were evaluated qualitatively. Based on our experience, a timeline for implementation was created to determine our organization's ability to regionalize the system in a timely manner.

RESULTS

User Acceptance:

Clinicians were surveyed at two and four months after initial system implementation. These surveys consisted of over 20 questions which were derived from various sources [1, 2, 3]. Highlights of the clinician surveys are presented in Figures 1 - 4.

After two months of use, 45% of clinicians agreed with the statement: "EpicCare is easy to use" (Figure 1). This number increased to 82% of clinicians after four months of use.

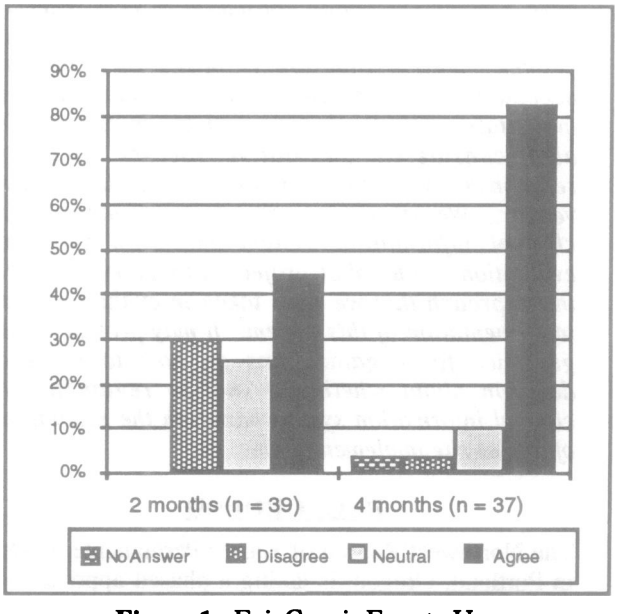

Figure 1: EpicCare is Easy to Use

At two months, 38% of clinicians agreed with the statement: "EpicCare is worth the time and effort

required to use it" (Figure 2). This number increased to 86% after four months of use.

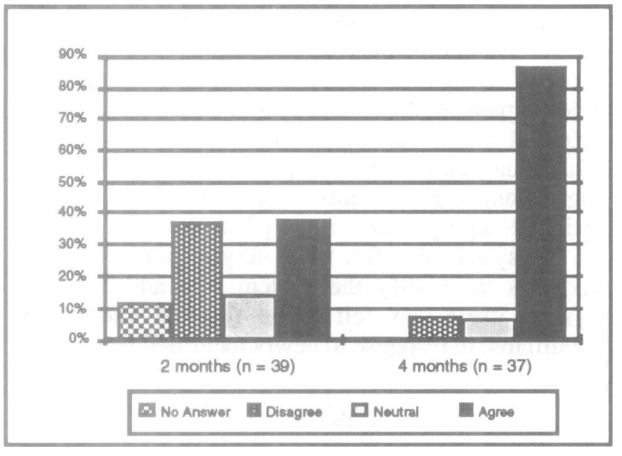

Figure 2: EpicCare is Worth the Time and Effort Required to Use it

Figure 3 shows clinician responses to the statement: "If given the choice, I would return to the old system." At four months, 89% of the clinicians would prefer not to return to the old system and 4% percent were neutral.

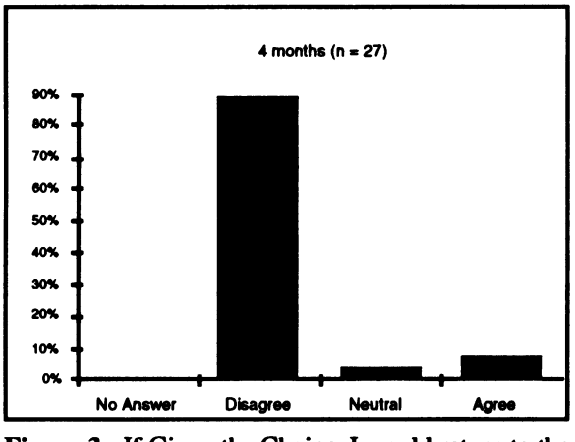

Figure 3: If Given the Choice, I would return to the old system (Clinician Responses to Survey)

Patient Satisfaction

Patient satisfaction with the system was measured indirectly through the clinician survey. Because of the many service-improvement initiatives being undertaken in this region, it would have been difficult to separate out improvements in patient satisfaction that accrued solely from the implementation of this CIS. This CIS has the potential of improving patient satisfaction by allowing the clinician to print out patient-specific instructions that are handed to the patient at the end of the visit, and through decreased waiting time for prescriptions and laboratory tests. Figure 4 shows clinician responses to this item. At two months, 46% of clinicians agreed with the statement "Patients seem more satisfied now that I am using EpicCare." This increased to 63% at four months, with 26% neutral to that statement and only 7% disagreeing.

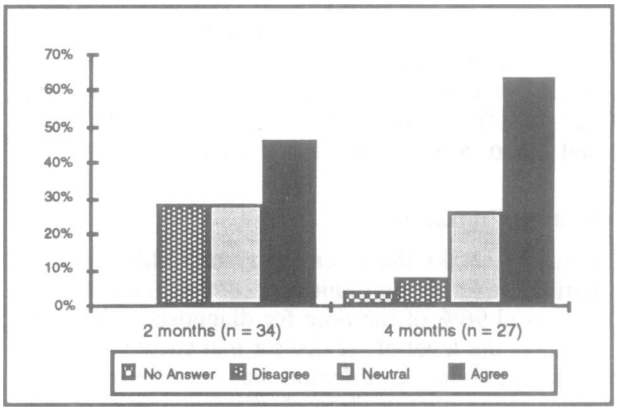

Figure 4: Patients seem more satisfied now that I am using EpicCare

Effect on Clinician Productivity:

Figure 5 shows the results of an industrial engineering study on the time spent by clinicians, on average, on the various tasks required in a clinic visit. On average, a clinician spent 2 minutes and 10 seconds longer per visit when using the system. Most of the difference in time can be ascribed to the extra time taken to enter the diagnosis and orders into the system. The system allows the clinician to print-out tailored patient instructions that are given to the patient at the end of the visit. Many of the clinicians made the effort to do so, which contributed to a portion of the extra time taken.

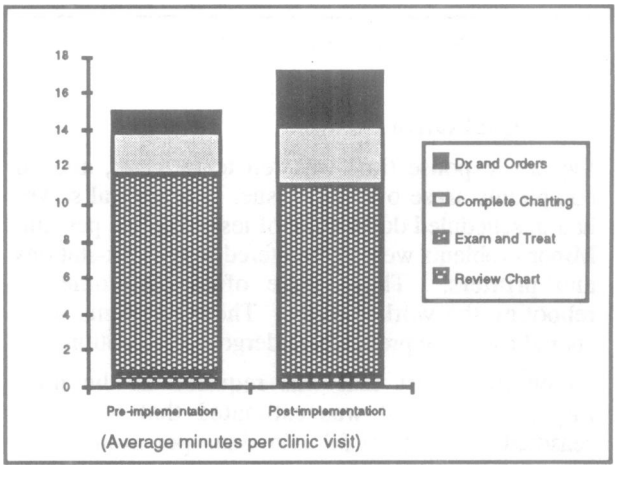

Figure 5: Task Distribution

Hands-on training took approximately 16 hours per clinician. In order to allow the clinician to learn to

use the system effectively, their schedule of patients was also modified. In the first week of going-live with the system, clinicians were scheduled to see half their normal load of patients. This load was increased as they became more accustomed to the system. By the end of two months, all clinicians were back to their pre-implementation patient load. The average decrease in "patient-seeing ability" was calculated out to be the equivalent of 31.5 hours. Thus, the estimated "cost" of implementation per clinician in hours of "decreased patient-seeing ability" was 31.5 + 16 = 47.5 hours. It is expected that this effect will diminish as the system is modified and improved to be more user-friendly.

System Utilization:

Figure 6 shows the extent of system utilization for various tasks in the clinical encounter. The system was used 96% of the time for diagnosis coding and entering the level of service for that encounter. This is the minimum information that must be entered in order to be able to "close" that encounter on the system. The system was used 79% of the time for prescribing, 78% of the time for laboratory test ordering, and 70% of the time for ordering radiology studies.

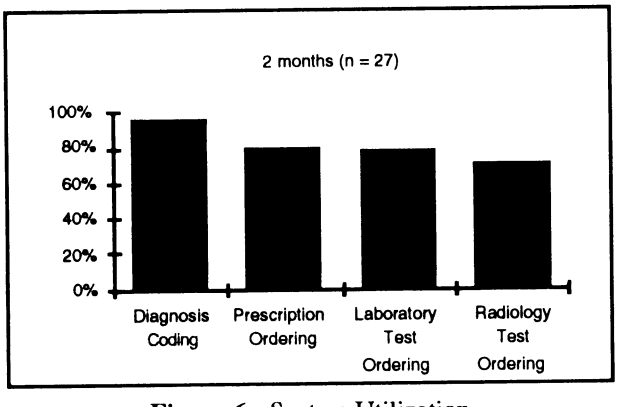

Figure 6: System Utilization

Other Qualitative Factors:

System response time was felt to be good, and no complaints arose over this issue. The central server had unscheduled down-time of less than one percent. Minor problems were encountered with work-stations and printers. These were often overcome by rebooting the work-stations. These problems were sporadic and are presently undergoing evaluation.

Given the effort that was required in the pilot implementation, it was estimated that we could reasonably bring up 50 clinicians per month in a subsequent regionalization of the system. With seven hundred total clinicians in this region, we estimated it would take fourteen months to roll-out the system to the entire region.

During the pilot phase, over one-hundred enhancements to the system were identified by the pilot clinicians and implementation team. These system enhancements were discussed with the vendor of the system. Many of the minor enhancements were added to the system as it evolved during the pilot implementation. The vendor developed and has released a new version of the system, Version 2.0. This enhanced version incorporates many of the more significant improvements suggested. Version 2.0 is being re-deployed in our two pilot sites. The vendor of this system was felt to be very responsive to our requests to modify the system. In addition, the system itself was felt to be flexible and easily modifiable in response to newly identified needs.

DISCUSSION

The current emphasis on cost-effectiveness in health care is creating new pressures on organizations to justify expenditures through detailed evaluations of the impact of new information systems [4].

Several authors have proposed cost/benefit models for the evaluation of health care systems [5, 6, 7]. Justifying systems on the basis of cost-benefit is, in many cases, a difficult exercise due to the many assumptions that must be made in doing such an analysis. A review of the "State of the Art" in cost-benefit analyses revealed several severe shortcomings [8]. Most cost-benefit analyses had serious problems due to lack of objectivity, methodological flaws, and inadequate handling of uncertainty. Gross assumptions, that may not be valid, are often made to cost-justify the expenditure needed to implement a given information system.

There is a dearth of information on how to go about making a decision on whether or not to deploy a particular clinical information system. Neither the latest Proceedings of the Annual Symposium on Computer Applications in Medical Care [9], nor the latest issue of Yearbook of Medical Informatics [10], have a single article devoted to this important topic. Weber [11] identifies a long "wish-list" of user needs and functional requirements of a system. However, he does not provide a methodology for system evaluation. Anderson [12] is a useful resource which includes a discussion of survey instruments that may be useful in evaluating health care information systems.

In our clinical information system deployment, we evaluated a pilot implementation based on criteria that we would like to see in a successful system. These criteria included: Clinician acceptance, effect on productivity, extent of use of the system, technical factors, ability to regionalize in a timely manner, flexibility and modifiability of the system, and relationship with and responsiveness of the vendor.

This pilot implementaion showed that clinician acceptance was high. Impact on productivity was measured, and in spite of the increased time needed to use the system, eighty-nine percent of clinicians had a preference to use the computerized system when compared to using the existing paper record system. Significant clinician resources were consumed due to decreased productivity while learning to use the system. This decreased productivity was estimated to be the equivalent of 47.5 hours per clinician. The diagnosis for a visit was entered in over 95% of patient visits. The system was used in over 70% of visits for prescribing and laboratory and radiology test ordering. With future improvements in the system, we believe that this usage level will increase. The system was felt to be technically adequate, flexible and easily modifiable. The vendor was responsive to our requests for modification and system improvement. Based on this evaluation, we have made a decision to regionalize the system pending user acceptance testing of the latest release of software from the vendor.

The approach taken in our evaluation of a vendor-supplied system may provide a guide for other organizations in making a decision on whether or not to regionalize a system based on a pilot-site implementation.

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